machine than others, it is, on the whole, unexcelled by any.

Since the issue of the first edition many inventions and improvements in this class of engine have been made, and the oil-engine, particularly, has been enormously perfected and widely introduced. The author has introduced into this edition two additional parts, has discussed the modern gas-engine more fully in the second part, and has devoted the third part entirely to the now well-established forms of oil-engine. He has drawn largely from his personal experience in this work, and has given a very thorough and remarkably judicial discussion of the merits, absolute and relative, of existing and commercially successful types and forms. Appended to the text is a complete list of British patents, from 1791 to its date, which will be found by the professional reader an exceeding valuable feature of the book.

The illustrations have been reproduced from working drawings and by expert draughtsmen. The originals have been obtained from many prominent makers as well as from the author's own portfolios.

The practical value of the work is, perhaps, best indicated by the fact that it has been translated into foreign languages and is adopted as a reference and text-book by many technical schools and colleges. For this latter use it is particularly well-adapted by its thoroughly logical form and exceptionally scientific methods. The author is entitled to the hearty thanks of all who are interested in his subject, and the publishers are no less deserving of credit for their admirable and conscientious work in making up the book. It is well-written and well-published, and will be found a real accession to every engineer's library in which it may find a place. It may well be questioned if any other work on this subject will prove more generally useful. R. H. THURSTON.

ITHACA, N. Y.

SCIENTIFIC JOURNALS.

PHYSICAL REVIEW, VOL. IV., NO. 2, SEPT.–OCT.

The Velocity of Electric Waves: By C. A. SAUNDERS. In this article Dr. Saunders describes experiments by which the velocity of electric waves traveling along wires was directly determined. The method involved the measurement of the length of stationary waves developed on long copper wires, and at the same time the determination of the frequency of these waves. The latter determination was made by photographing the oscillatory spark from which the waves in question originated. The method used seems quite similar to that employed by Prof. Trowbridge and Mr. Duane, and the results indicate about the same value for the velocity, viz., from 2.954×10^{10} cm. per sec. to 2.998×10^{10} cm. per sec. The method used is seen to be a *direct* one, and does not depend upon any assumption regarding the manner in which the oscillations are set up. The close agreement obtained between the velocity of electric waves and velocity of light is for this reason especially satisfactory.

On the Measurement of the Expansion of Metals by the Interferential Method, II.: By E. W. MORLEY and W. A. ROGERS. In the first part of this paper the general outline of the method used, as well as many of the important practical details, were discussed. In the present article the numerical data are given for a test of the method, and the computations of the results are presented. Using a bar of Jessop's steel, the authors find for the coefficient of expansion between the temperatures of 0 and 65° a value of 10.45μ. This result compares quite favorably with the values 10.58 and 10.51 obtained by other methods. The authors do not consider, however, that the method has been given a fair trial, since a series of accidents caused the temperature measurements to be far less accurate than was to be desired.

An Experimental Study of Induction Phenomena in Alternating Current Circuits: By F. E. MILLIS. In the present article Dr. Millis has devoted his attention especially to the phenomena of charge and discharge in condenser circuits, making use of the alternating current galvanometer previously described by himself and Mr. Hotchkiss. The current curves for charge and discharge, under a variety of conditions, have been photographed. The needle used, which was so light as to follow the variations in cur-

rent almost instantly, was adjusted in these experiments so as to have a natural period of vibration of 8,500 complete periods per second. Under these circumstances it can hardly be questioned that the curves obtained represent the actual variations of current in the circuit. In measuring the oscillatory charge and discharge of condensers, Dr. Millis has obtained some beautiful curves, reproductions of which accompany the article. The agreement between the computed and observed period of oscillation is in most cases within two or three per cent. Curves showing the effect of an iron core in the self-induction coil are especially interesting. The damping of the oscillations, caused by the eddy currents developed in the iron, is very noticeable, and it is found that a thin tube of iron is as effective in producing this damping as is a solid core.

Admittance and Impedance Loci: By F. BEDELL. This paper deals with the application of the principles of geometrical inversion to the graphical treatment of alternating current problems. As a result of the reciprocal relation between admittance and impedance Dr. Bedell shows that it is always possible to proceed from a polar diagram representing one problem, to a second diagram which may be interpreted in connection with what might be called the *inverse* problem. Several special cases are discussed, but their presentation here would carry us beyond the limits of this extract.

Visible Electric Waves: By B. E. MOORE. While repeating some of the experiments of Lecher on stationary electric waves along wires Mr. Moore found that under certain conditions the whole wire became luminous, the nodes and loops of the electric waves being clearly indicated by the form of the hazy light surrounding the wire. This article describes the conditions under which the phenomena are obtained. This method of showing the presence of electrical waves will doubtless prove most instructive and useful for lecture illustration.

Note on the Refractive Index of Water and Alcohol for Electric Waves: By J. F. MOHLER. The writer calls attention to a source of error in experiments previously described by Prof. Cole (Phys. Rev., Vol. IV., p. 50).

Book Notices. Nernst: Theoretical Chemistry; Landauer: Spectralanalyse; Gage: Principles of Physics.

NEW BOOKS.

Elements of Physics. Vol. II. *Electricity and Magnetism.* EDWARD L. NICHOLS and WILLIAM S. FRANKLIN. New York and London, The Macmillan Co. 1896. Pp. ix+272. $1.50.

Alternating Currents and Alternating Current Machinery. Vol. II. DUGALD C. JACKSON and JOHN PRICE JACKSON. New York and London, The Macmillan Co. 1896. Pp. xvii+729. $3.50.

Problems in Elementary Physics. E. DANA PIERCE. New York, Henry Holt & Co. 1896. Pp. vii+194.

A Manual of Quantitative Chemical Analysis. FREDERICK A. CAIRNS. Third Edition. Revised and enlarged, by ELWYN WALLER. New York, Henry Holt & Co. 1896. Pp. xii+427.

Trigonometry for Beginners. By REV. J. B. LOCK. Revised and enlarged by JOHN A. MILLER. New York and London, The Macmillan Co. 1896. Pp. 147+63. $1.10.

The Report of the Michigan Board of Agriculture, 1895. Pp. 900.

General Principles of Zoology. RICHARD HERTWIG. Translated by GEORGE W. FIELD. New York, Henry Holt & Co. 1896. Pp. xii+226.

The Human Body. H. NEWELL MARTIN. Seventh edition, revised. New York, Henry Holt & Co. 1896. Pp. vii+685.

A Handbook of Rocks for Use without the Microscope. JAMES FURMAN KEMP. New York, Printed for the author. 1896. Pp. vii+176. $1.50.

Pioneers of Science in America. Reprinted with additions by WILLIAM JAY YOUMANS. New York, D. Appleton & Co. 1896. Pp. viii+508.

Erratum: IN the report of the papers read by Prof. D. T. MacDougal before Section G., A. A. A. S., the last two paragraphs (on page 624) should be placed after the first paragraph on the second column on page 435.